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(71) Applicant *(for all designated States except US)*: **NAVITAL (UK) LIMITED** [GB/GB]; Roddens House, 13 Roddens Road, Ballywater BT22 2RN (GB).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **VAN YSSELDIJK, Pieter** [NL/GB]; Roddens House, 13 Roddens Road, Ballywater BT22 2RN (GB).

(74) Agent: **MURGITROYD & COMPANY**; Scotland House, 165-169 Scotland Street, Glasgow G5 8PL (GB).

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(54) Title: SEAFOOD PRODUCT AND PROCESS

(57) Abstract: A process for preparing ready-to-cook seafood is described. The process comprising the steps of: (a) locating the seafood in a ready-to-cook container; (b) sealing the container under partial, substantial or full vacuum; and (c) allowing the container and seafood to undergo ultra high hydrostatic pressure. Thus, the seafood remains "raw", i.e uncooked, but is at least partially sterilised from infectious agents. The seafood also retains its spores and enzymes, hence its taste and quality. The effect of at least partial sterilisation of the product within the container during the hydrostatic pressure and any added gas mixture provides a product with a significantly extendedshelf life, from several days to possibly several weeks, facilitating easier subsequent storage, transportation and sales.

"Seafood Product and Process"

The present invention relates to ready-to-cook, hermetically sealed pre-packed food, including seafood, and especially shellfish, that has been hydrostatically pressurised alive or very fresh in order to maintain highest product qualities.

Processing fish and shellfish suitable for supermarket shelves is an expensive and difficult exercise. This is primarily due to the fact that shellfish and other fish items must be processed alive or as fresh as possible to give a high quality end product.

The main spoilage mechanisms affecting the quality of fish and seafood products are the result of microbial and oxidative activities. Fish and other seafood are very perishable due to their high Aw, neutral pH, and the presence of autolytic enzymes, which cause the rapid development of undesirable odours and flavours.

Currently, live fish and shellfish are stored in tanks or ponds on fishing vessels, and trucked in tanks or containers for processing or transport to the market place. These tanks or containers are naturally heavy and are very costly loads to carry, contributing to the overall expense and risk associated with volatile and delicate products like fresh fish and shellfish.

The use of cold sterilisation using ultra high hydrostatic pressure in hyperbaric chambers as a method for seafood preservation is known. However, after processing using hydrostatic pressure, the seafood is presented without any form of protection. The absence of suitable packaging for the processed product will result in a considerable loss of structural integrity and connectivity.

Other methods of preservation involve the use of high temperatures, for example pasteurisation, but they degrade the original and natural texture quality of the seafood meat..

It is an object of the present invention to provide an improved product and process that uses the ultra high hydrostatic pressurised technique, but which has the advantage of packaging the seafood in a hermetically sealed, sterile container, thereby providing the customer with sterilised seafood having retained raw qualities in a "ready to cook" format.

According to one aspect of the present invention, there is provided a process for preparing "ready to cook" seafood comprising the steps of:

(a) locating the seafood in a ready to cook container;

(b) sealing the container under partial, substantial or full vacuum; and

(c) allowing the container and seafood to undergo ultra high hydrostatic pressure.

Thus, the ultra high hydrostatic pressurisation provides at least partial sterilisation of the seafood. The seafood remains "raw", i.e. uncooked, but is at least partially sterilised from infectious agents. The seafood also retain its spores and enzymes, hence its taste and quality. The effect of at least partial sterilisation of the product within the container during the hydrostatic pressure and any added gas mixture will provide the product with a significantly extended shelf life, from several days to possibly several weeks, facilitating easier subsequent storage, transportation and sales.

Such sterilisation is 'cold', as opposed to the more general heated sterilisation which typically occurs at >100-120°C. The seafood product of the present invention still requires cooking to effect heated sterilisation of the seafood, but the cooking can be effected from the same (sealed) container.

The added quality of using a sealed and sterile container for the hydrostatic processing and for the subsequent presentation is that shellfish will retain its original appearance and colours. In the case of bivalve molluscs, the container will keep the bivalve shells in a closed form, whereby the meat will still be contained within the two shells. An effect of hydrostatic pressure above a minimum pressure and during a minimum period of time is to open the shells and separate the meat from the shells. A sufficiently vacuum-drawn and sealed container will prevent the shells from opening and the meat from falling out.

Furthermore, in particular in the case of crustaceans, the combination of hydrostatic pressure and sealed containers will preserve the original and natural colour of the shells for a considerable period of time (i.e. from a few days to a few weeks after processing).

The atmosphere in the container could be altered before sealing. The degree of vacuum forming depends on the nature of the seafood, and the nature of any other content of the container, including any 'different' atmosphere. Essential though is to keep the seafood, particularly bivalve molluscs, 'closed', i.e. as close to the live condition as possible. This is achieved by sealing the container and maintaining the seal until cooking, and possibly eating.

Preferably the ultra high hydrostatic pressurisation of the seafood comprises exposing the seafood to pressures greater than 2000 bar, more usually more than 3000 bar, in a hyperbaric chamber for at least 0.5 seconds and temperature range between -10 and 80°C, at least once. One such exposure is termed a pressure cycle.

Preferably the seafood undergoes a plurality of pressure cycles.

Preferably the seafood is a bivalve shellfish.

Any suitable shellfish can be used with the present invention, including molluscs and crustaceans such as mussels, clams, scallops, crabs, lobsters, etc.

Preferably the shellfish are punctured so as to render them more suitable for hydrostatic treatment; generally to release air from inside the shellfish.

Preferably the pressurised seafood is enveloped by a hermetically sealable container. More preferably, such a container is made from a suitably heat resistant and durable plastic. This could be a durable but flexible bag, in which the seafood is ready to cook.

The term "ready to cook" as used here refers to something which is capable of immediate cooking,

such as boiling, without further preparation. The seafood is then cooked in the container.

Preferably the container further comprises top opening mechanism and/or a handle, for pressure relief during cooking.

Preferably the seafood is packed in the container in or separately with one or more cooking ingredients such as a sauce; this allows cooking of the seafood with a desired flavour or taste without removal from the container.

The seafood could be packaged with other food products that can be ultra high hydrostatically pressurised (and subsequently cooked) alongside the seafood.

In one embodiment of the present invention, seafood is sealed in a container with one or more suitable gases such as carbon dioxide, oxygen and nitrogen, possibly as a mixture (e.g. containing 35%-45% carbon dioxide, 25%-35% oxygen and 25%-35% nitrogen) that will be compressed during hydrostatic pressure, and return to its initial volume afterwards. The gas (mixture) with the seafood's own juices and possible added sauces and vegetables would also prevent compression of the package against the shells, avoiding structural damage.

The seafood could be enveloped in other containers, e.g. double wrappings. Other suitable ready to cook packagings are known.

According to a second aspect of the present invention, there is provided a ready to cook seafood product whenever prepared by a process of the present invention.

Preferably the seafood is a shellfish.

Embodiments of the present invention will now be described by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a diagrammatic representation of a hermetically sealed stand-up pouch with pressurised mussels packed inside; and

Fig. 2 is a diagrammatic top view of a stand up pouch enveloping two semi-vacuumed and sealed stand-up pouches, one of which contains pressurised crabs and the other pressurised mussels.

Figure 3 is a hermetically sealed plastic tray containing pressurised mussels, suitable for microwaving.

Referring to the Figures, Figure 1 shows a semi-vacuum sealed stand-up pouch 1 with ultra high hydrostatically pressurised mussels 2 packed inside. The pouch 1 has an easy to carry handle 4 and a top

opening mechanism 6. The pouch 1 could equally carry other seafoods such as crabs, etc.

Figure 2 shows a second stand-up pouch 8 containing two semi-vacuum sealed stand-up pouches 10 and 12 with ultra high hydrostatically pressurised mussels 22 packed in one pouch 10 and ultra high hydrostatically pressurised crabs 14 packed inside the other pouch 12. A further handle 24 and opening mechanism 26 are also provided therewith.

Figure 3 shows ultra high hydrostatically pressurised mussels 32 packaged in a microwave-able container 30 which comprises a box 33 and a hermetically sealed plastic lid 34. The mussels 32 are surrounded by a garlic sauce and vegetables 36.

In production of the above products, air is expelled from the shellfish-containing stand-up pouch 1 (or pouches 10, 12 or container 30), and a gas mixture comprising 35-45% carbon dioxide, 25-35% oxygen and 25-35% nitrogen is introduced. The pouch 1 is then hermetically sealed, and then placed in a hyperbaric chamber. The sealed stand-up pouch is then treated under a pressure greater than 3000 bar, at 25°C, for 1 minute. This is a "pressure cycle".

After at least one half-second hydrostatic pressure cycle, the mussels 2 no longer retain connectivity between the mussel body parts and their inner surfaces.

The airtight semi vacuum sealed pouch 1, containing the mussels 2 and the gas mixture, is now ready to be cooked. It can be stored for at least several days, possibly up to several weeks, at between 0°C and 2°C. Before cooking, the pouch top is opened, using the opening mechanism 6, in order to allow complete heat transfer and venting of steam during the cooking process, especially when the contents are microwaved.

The present invention provides a process for a simple seafood product that has extended shelf life, whilst retaining their rawness, and thus taste and quality for the consumer, in a cookable form already familiar to the customer.

Furthermore the stand-up pouch provides the advantage of the use of only one container to hold the shellfish for both the hydrostatic pressurisation and the cooking, as well as transport and 'selling'.

Other containers, such as hermetically sealable trays, can be used that can withstand the hydrostatic pressure process, but which are also capable of use in microwave ovens.

Claims

1. A process for preparing ready-to-cook seafood comprising the steps of :

   (a) locating the seafood in a ready-to-cook container;

   (b) sealing the container under partial, substantial or full vacuum; and

   (c) allowing the container and seafood to undergo ultra high hydrostatic pressure.

2. A process as claimed in Claim 1 wherein the pressurisation of the seafood comprises exposing the seafood to a pressure cycle comprising a pressure greater than 2000 bar for at least 30 seconds and within a temperature range of between -10 and 80°C.

3. A process as claimed in Claim 2 wherein the pressure is greater than 3000 bar.

4. A process as claimed in Claim 2 or Claim 3 wherein the seafood undergoes a plurality of pressure cycles.

5. A process as claimed in any one of Claims 1 to 4 wherein the seafood is a shellfish, preferably a bivalve shellfish.

6. A process as claimed in Claim 5 where the shellfish is one or more of the group comprising mussels, clams, scallops, crabs and lobster.

7. A process as claimed in Claim 4 or Claim 5 wherein the shellfish remains closed after pressurisation.

8. A process as claimed in any one of Claims 4 to 6 wherein the shellfish wholly or substantially maintains its colour after pressurisation.

9. A process as claimed in any one of Claims 4 to 8 wherein the shellfish is or are punctured prior to pressurisation.

10. A process as claimed in any one of the preceding Claims wherein the container is hermetically sealed.

11. A process as claimed in any one of the preceding Claims wherein one or more cooking ingredients are located with the seafood in the container, and sealed therewith.

12. A process as claimed in anyone of the preceding Claims wherein the seafood and container are located in a further container or packaging.

13. A seafood product whenever prepared according to a process of any one of the preceding Claims.

14. A seafood product according to Claim 13 enveloped in a hermetically sealed pouch or container.

15. A seafood product as claimed in Claim 14 wherein the pouch or container is formed from a heat-resistant and durable plastic material.

16. A seafood product as claimed in anyone of Claims 13 to 15 wherein the container includes a top opening mechanism.

17. A seafood product according to any one of Claims 13 to 16 which includes one or more cooking ingredients.

18. A seafood product as claimed in Claim 17 wherein the one or more cooking ingredients is selected from the group comprising sauces, vegetables, herbs, spices, oils, or a combination thereof.

19. A shellfish product as claimed in any one of Claims 13 to 17 wherein the seafood is a shellfish, preferably a bivalve shellfish.

20. A seafood product as claimed in Claim 19 wherein the shellfish is one or more of a group

comprising mussels, clams, scallops, crab and lobster.

21. A seafood product as claimed in Claim 19 or Claim 20 wherein the shellfish is closed after the pressurisation.

22. A seafood product in any one of Claims 19 to 21 wherein the shellfish wholly or substantially maintains its colour after the pressurisation.

23. A seafood product as claimed in any one of Claims 13 to 22 wherein the container is located in a further container or packaging.

24. A seafood product as claimed in anyone of Claims 13 to 23 wherein the seafood is sealed in the container with one or more gases.

25. A seafood product as claimed in Claim 24 wherein the gas is one or more selected from the group comprising carbon dioxide, oxygen and nitrogen.

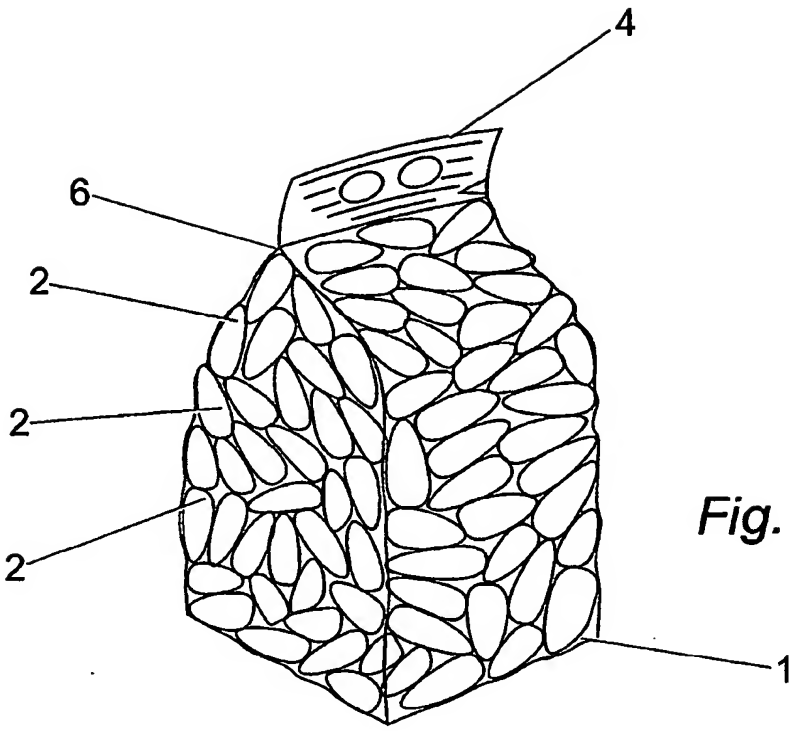

Fig. 1

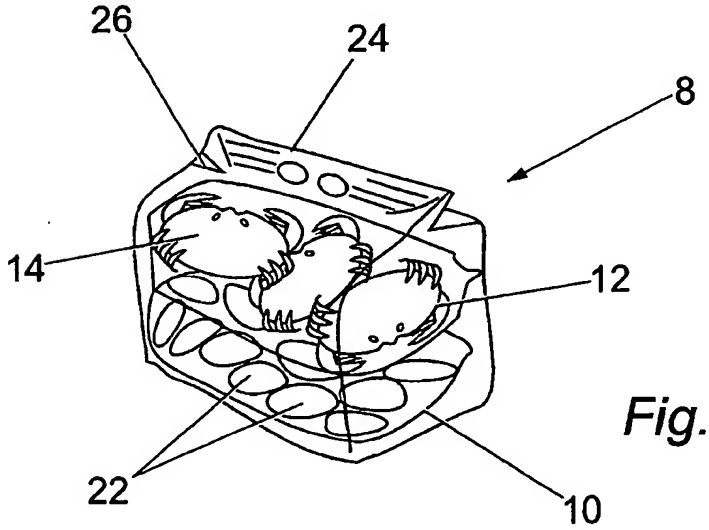

Fig. 2

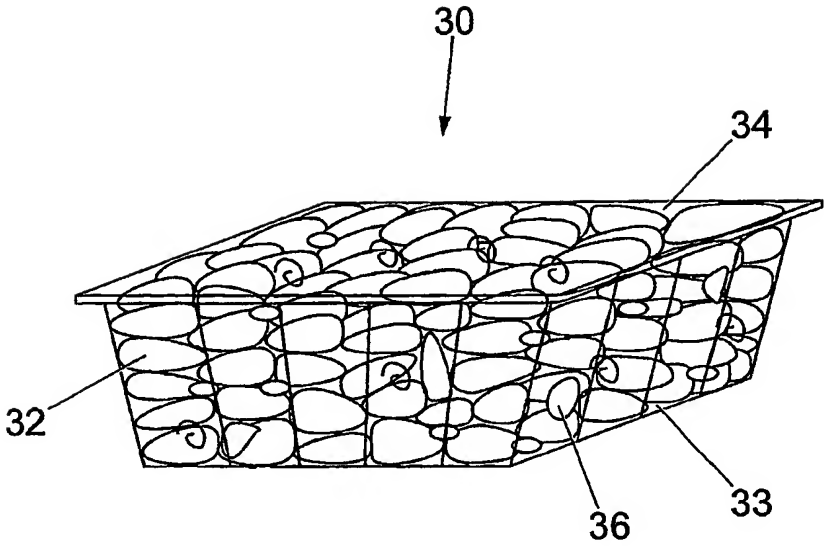

Fig. 3